

## Ontario Power Generation's Nanticoke Power Plant



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**N**anticoke Thermal Power Station, situated on Lake Erie near Port Dover, Ontario, Canada, is Ontario Power Generation's largest, and one of the world's largest, coal-fueled plants. Nanticoke Station has a total nameplate capacity of 4,000 MW from eight Parsons 500 MW turbine generator sets. The plant covers a land area of 324 hectares (800 acres) and has approximately 600 personnel on staff.

Ontario Power Generation (OPG), a crown corporation, was known as Ontario Hydro until April 1999. This name change more accurately reflects its current status as a world-class electric company, one of the largest electric utilities in North America, as measured by installed generating capacity. OPG has 69 hydroelectric, six fossil fuel, and five nuclear power stations, with a total installed capacity of 30,873 MW. The generation mix is 45% nuclear, 31% fossil, and 24% hydroelectric.

### Machine description

Each turbine generator at Nanticoke is a tandem compound, eleven-bearing machine, which consists of a high pressure, an intermediate pressure, and two low pressure cases, as well as a generator.



**Nanticoke Power Plant from the air.**

Each steam turbine is a Parsons 500 MW, 3000 rpm "GEC Erith" type, modified to run at 3600 rpm for the North American market. Each generator is a Parsons Newcastle design, which has pedestal-mounted bearings separate from the generator casing.

### Past problems

Historically, Nanticoke's turbine generator sets suffered the following operating concerns:

- Generator thermal problems.

- Shaft cracking.
- High pressure and intermediate pressure rotor blade loss.
- Low pressure rotor frequent balancing changes.

Additionally, the existing turbine supervisory system was obsolete, and spare parts were no longer available. The system consisted of old technology transducers, including spring/mass velocity pickups, which were case-mounted on the bearing caps. Critical machinery data was either unavailable or cumbersome to compile. It could not detect a variety of vibration conditions peculiar to these types of units, including shaft cracking. OPG had a portable diagnostic system installed, which was moved from unit to unit. The combination of these factors manifested itself into an overall need to upgrade and update the turbine supervisory system.



**View of the turbine floor showing one of the eight Parsons 500 MW turbine generators.**

## The solution

A Turbine Supervisory Instrumentation (TSI) system consists of transducers and monitoring systems that continuously monitor key machinery conditions on large steam turbine generators (see Table 1 for a list of parameters measured on Nanticoke's units). OPG used the tender process to solicit proposals from a variety of vendors for the design and installation of new TSI systems to replace their aging systems. Bently Nevada was contacted specifically because of our 20 years of experience, not just in providing the hardware, but actually installing it on the machine as well.

When evaluated against OPG's criteria, Bently Nevada emerged as the choice that best satisfied the requirements. In addition to TSI systems for all eight units at Nanticoke, OPG decided to install a complete machinery management system. As a result, our scope of supply included 3500 Series Turbine Supervisory Instrumentation systems, Data Manager® 2000 (DM2000), Machine Condition Manager™ 2000 (MCM2000), and the extensive services required to deliver a fully functional solution, integrated into the plant information network.

These services included many disciplines, such as system engineering, system integration, electrical designs, electrical labor and materials, mechanical designs, machining labor, system commissioning, project management, documentation, and supervision.

Installation and commissioning of this complex operation required coordination among many of Bently Nevada's departments, including Manufacturing, Project Engineering, Mechanical Engineering, Systems and Instrumentation, Machinery

Parameter	Transducer type	Location
Shaft radial vibration	XY proximity probes	Each bearing (11)
Bearing cap vibration	XY seismic transducers	Each bearing housing (11)
Differential expansion	50mm Differential Expansion (Proximity) Transducer	HP case IP case LP cases 1 and 2
Eccentricity	Proximity probe	HP shaft IP shaft
Cylinder expansion	DC LVDT	HP case IP case
Turbine speed	Proximity probe	Generator end
Rotor zero speed	Proximity probe	Generator end
Valve position	AC LVDT	Governor valve (4) Intercept valve (4) Main stop valve (2)
Load limit	AC LVDT	Governor end
Vibration phase reference	Keyphasor® probe	Generator end
Temperature	RTD	Thrust bearing
Shaft position	Proximity probe	Thrust bearing (2)

**Table 1. Summary of TSI measurement parameters at Nanticoke.**

Management Services, System Integration Engineering, and Training. Additionally, a coordinated effort was required among the Bently Nevada-subcontracted labor for the mechanical and electrical installation, the turbine overhaul contractor, and OPG's supplied labor.

### Done on time and within budget

Bently Nevada's experience in managing projects resulted in the new system being installed on time and within budget. Bently Nevada's Systems Engineering & Services is continuing to work with OPG after commissioning to optimize the system. Bently Nevada's system is considered to be reliable, cost-effective, and provides advanced and meaningful information to the operator and the vibration analyst before damage to the turbine generator takes place.

The 3500 Series Machinery Protection System was used for this project. It consists of the following monitors: Vibration, Thrust/Shft

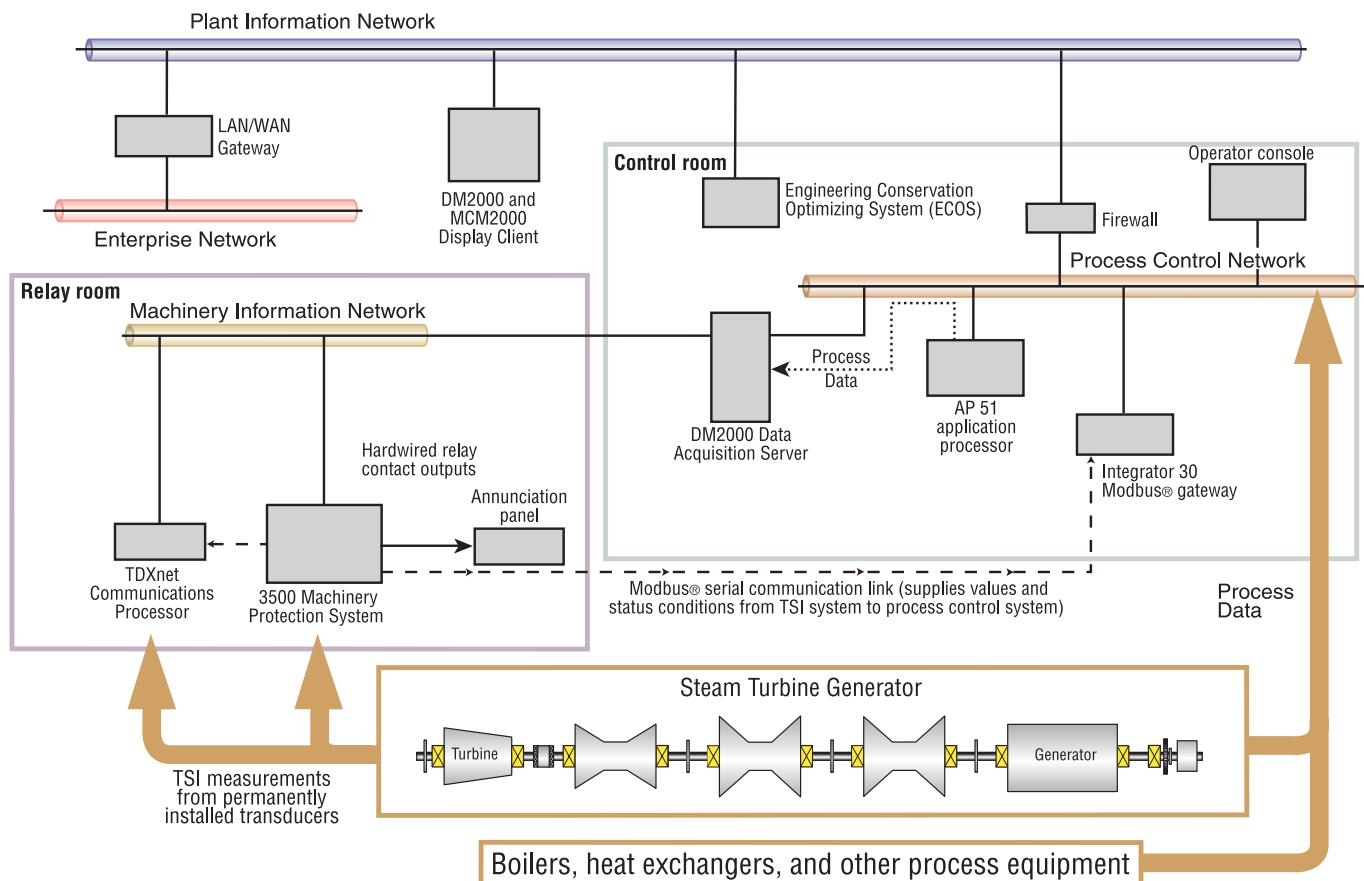
Position, Eccentricity, Case or Cylinder Expansion, Differential Expansion, Valve Position, Temperature, and Speed. In addition to measuring shaft rotative speed, the Keyphasor® signal can also be used for phase reference and diagnostics. The 3500 System with TDXnet™ Communication Processors installed in a custom cabinet will interface with the plant's Foxboro I/A Series process control system and Bently Nevada's DM2000 and MCM2000 Machinery Management Software (Figure 1).

### System performance

The Bently Nevada 3500 System continuously measures and monitors the variety of supervisory parameters. This critical information permits early identification of machinery problems. Previously, this full complement of values was not available to operators and vibration analysts.

### System benefits

Seven out of eight units have been commissioned so far, and we fully



**Figure 1.** General overview of the turbine generator.

expect to meet all of OPG's functional requirements. So far, OPG has realized the following benefits from its Bently Nevada equipment:

1. OPG has been able to correlate vibration levels in the #1 bearing of each unit to the governor valve position.
2. Unit #6 was experiencing uneven distribution of steam. The data provided by DM2000 helped OPG operators regulate the valves properly.
3. Malfunctioning valves are being more quickly diagnosed because of the information provided by the turbine supervisory system.
4. Unit #6 experienced a wipe of the #2 bearing during a coastdown. The data provided by DM2000 Software helped plant personnel

diagnose the problem.

5. Unit #5 experienced a change in balance condition on the LP rotor during steady state running conditions. Data on the change, provided by the 3500 System, triggered an alarm, which alerted the operators to the problem.
6. The system allows off-site access to vibration data. This permits OPG's vibration specialists to view Nanticoke's system from other facilities. There has been an almost immediate resource savings on a per-unit basis, as well as improved information gathering.

## Conclusion

In addition to providing excellent hardware and software, Bently Nevada also has a commitment to, and a proven

record of, **reliability, extensive field experience, and excellence in personalized customer service**. The scope of OPG's Nanticoke project demonstrates Bently Nevada's extensive project management capabilities and ability to supply the many specialized disciplines needed to complete such a project in a turnkey fashion. OPG was able to work with a single contractor, Bently Nevada, which coordinated and completed all aspects of the project. As a result, the project was a complete success; OPG is already experiencing positive payback from the system. ☐